VERMONT AGENCY OF NATURAL RESOURCES

Draft Water Quality Certification
(33 U.S.C. §1341)

In the matter of: Green Mountain Power Corporation
163 Acorn Lane
Colchester, VT 05446

APPLICATION FOR WATERBURY HYDROELECTRIC PROJECT

The Vermont Department of Environmental Conservation (the Department) has reviewed a water quality certification application dated December 11, 2013 and filed by the Green Mountain Power Corporation (GMP or the applicant) for the Waterbury Hydroelectric Project (Project). The supporting documentation for the application includes the applicant's Federal Energy Regulatory Commission (FERC) license application dated August 27, 1999; other supporting documents filed by the applicant in support of prior certification requests; and a proposal for certification filed with the Agency of Natural Resources (ANR) on December 4, 2012, a copy of which is appended to this decision. The record for this decision includes the February 1, 2001, FERC Additional Information Request (AIR) response; the FERC Environmental Assessment (EA) dated August 20, 2004; and many other documents related to the project and its relicensing.

The current application is subject to review under the Vermont Water Quality Standards adopted by the Natural Resources Board and effective beginning December 30, 2011 (Standards). (Standards, Section 1-01(A) Applicability).

The Department, based on the application and record before it, makes the following findings and conclusions.

Findings

Background and General Setting

1. The Waterbury Hydroelectric Project is located at Waterbury Dam on the Little River approximately 2.7 miles upstream of the river mouth and about two miles northwest of the Waterbury village. Waterbury Dam impounds Waterbury Reservoir, which extends approximately 4.2 miles upriver at normal pool elevation. Of the Little River's 112 square mile watershed, the project utilizes runoff from an area of 109 square miles.
2. The Little River drains significant portions of Washington and Lamoille counties and a small portion of Chittenden County. The mainstem of the river begins at the confluence of Moss Glen Brook and Sterling Brook in the town of Stowe. The West Branch, which has its headwaters in Smugglers Notch, joins the mainstem in Stowe village. The river

then flows generally south and west to its confluence with the Winooski River west of Waterbury village. The Little River drainage constitutes approximately 10 percent of the total Winooski River watershed.

3. The headwaters of the Little River comprise pristine headwater streams, some originating on the east slope of Mt. Mansfield, Vermont's highest mountain. Portions of the watershed are heavily developed, especially the state and adjacent private lands associated with the Stowe Mountain Resort and the valley along the West Branch to Stowe Village. Between Stowe and the upper end of Waterbury Reservoir, the setting is more rural. The shoreline of the reservoir is almost exclusively in state ownership and is mostly undeveloped.

4. The Federal Energy Regulatory Commission first licensed the project as Project No. 2090 on July 20, 1954, with an expiration date of September 1, 2001. The project has been operating under annual license extensions since the original license expired.

Project and Civil Works

5. Waterbury Dam was constructed by the Civilian Conservation Corps under the direction of the U.S. Army Corps of Engineers (USACE) from 1935 to 1938 for the purpose of flood control. Construction followed the devastating flood of November 1927. Waterbury Dam is one of three flood control dams built in the Winooski River watershed during this period, the others being at Wrightsville and East Barre. It is owned and operated by the State of Vermont, Department of Environmental Conservation. The hydroelectric facility is separately owned and operated by GMP under the terms of an agreement between the State and GMP providing for transfer of the lands from GMP for original construction of the flood control dam.

6. The primary purpose of the dam is flood control, which was its sole use up until the hydroelectric facility first started operations in 1953.

7. The dam is a zoned earthfill structure, 2,130 feet long and 187 feet high, with a non-overflow crest elevation of 633.0 feet NGVD (all elevations referenced herein are NGVD 1929 datum). The principal spillway is a concrete structure located at the left (east) end of the dam with a crest elevation of 592.0 feet. It is fitted with three tainter gates that are 20, 20 and 35 feet long. Located immediately to the right of the principal spillway, the emergency spillway is a fixed crest concrete structure with a crest elevation of 617.5 feet and an effective length of 153.5 feet. In addition, there is a submerged outlet structure and conduit controlled by a Broome gate; the inlet invert elevation is at elevation 500 feet. The conduit transitions to two 54-inch-diameter steel penstocks that direct water to a valve house where they merge and supply a 79-inch-diameter penstock for the Project turbine and a 48-inch-diameter bypass pipe controlled by a Howell-Bunger valve. The bypass pipe was installed in 1985 for emergency drawdown purposes.

8. The dam has had two major repair projects, the first in 1985-87 and the second, as mentioned previously, in 2000-06. Another major project is being planned to correct

tainter gate structural problems and provide sufficient dam freeboard (the height between the design reservoir flood stage and the non-overflow dam crest) under new design criteria for the peak outflow. The preferred alternative is to replace the existing gates with three new gates each with a width of 32 feet and sills reconstructed at the current elevation of 592.0 feet. The total gate opening would be increased from 75 feet to 96 feet with the section being extended to the right (west). This design would result in a freeboard of 3.5 feet compared to the present freeboard of 0.6 foot.

9. The Department will enter into a Project Cooperation Agreement with the federal government, through the U.S. Army Corps of Engineers, to undertake spillway replacement, which includes the gate repairs. Congress must authorize and appropriate funds for the project. In addition, the State of Vermont, as the Non-Federal Sponsor, will be responsible for a portion of the funds for the project. The most recent estimate for the project cost is approximately $40,000,000. Typically, the federal government covers approximately 65% of the project costs. The project has not yet been designed and funded. However, as it relates to dam safety, it is a priority for the Department. (Waterbury Dam, Waterbury, Vermont, Design Documentation Report for Spillway Replacement, USACE, March 2006). The Department intends to submit a letter to the federal government initiating discussions regarding entering into a Project Cooperation Agreement.
10. Once the spillway replacement project has been completed and the federal government has transferred the project to the State for operations consistent with the federal government's recommendations, as described in the applicable Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (OMRR&R), Stage III of operations will be implemented by the applicant as described herein.
11. At a normal maximum pool elevation of 592.0 feet elevation, the reservoir has a surface area of 890 acres and an estimated gross storage of 37,000 acre-feet. At its normal summer elevation of 589.5 feet, the reservoir area is approximately 868 acres with 35,000 acre-feet of storage.
12. The concrete powerhouse, constructed in 1953, houses a single vertical Leffel Francis turbine rated at 7,800 horsepower under a net design head of 138 feet. The normal tailwater elevation is about 443.5 feet. In February 2009, the applicant replaced the turbine runner with one that is more efficient and has a 14% greater hydraulic capacity than the original one. The unit now has an operating range of approximately 85-670 cfs.[1] The turbine drives a General Electric generator with a nameplate rating of 5,520 kW.
13. During construction of the dam, the reach immediately downstream was heavily altered. The tailrace discharges to a pool located in the approximate location of the original river channel. The dam spillways, when active, discharge through a bedrock channel that rejoins the river approximately 400 feet downstream from the tailrace pool.

[1] Letter from Andrew Qua, Kleinschmidt Associates, to Kimberly Bose, Secretary, FERC, seeking a license amendment on GMP's behalf, May 27, 2011.

14. The plant produces an average annual output of 16,233 MWh.

15. Project transmission facilities consist solely of a 4,160 volt line that carries electricity from the powerhouse to a 6,000/7,400 kVA transformer located immediately west of the powerhouse that steps up the generator output from 4,160 to 33,000 volts. The substation and transmission line to the Waterbury switching station are part of GMP's transmission network.

16. Because the dam was built by a federal entity, FERC classifies the dam as a governmental dam, and the dam and reservoir are not included within the boundaries of the hydroelectric project.

River Hydrology and Streamflow and Reservoir Regulation

17. Since 1935, the U.S. Geological Survey (USGS) has operated a surface water gaging station (No. 04289000) on the Little River 0.8 mile downstream of Waterbury Dam. The drainage area at the gage site is 111 square miles, only slightly more than the drainage area of 109 square miles at Waterbury Dam. The following hydrologic statistics are available for the dam site based on a drainage area proration of statistics from the gage data through water year 2012:

Mean annual flow	249 cfs
Annual runoff	31.0 inches
10 percent exceedance	561 cfs
50 percent exceedance	191 cfs
90 percent exceedance	10 cfs
7Q10	2.8 cfs (period of record through 2012)

18. Inflows to Waterbury Reservoir are essentially unregulated. Stowe Mountain Resort withdraws water from the West Branch for snowmaking and golf course irrigation. A small, run-of-river[2] hydroelectric project is located at Moscow Mills approximately 2.6 miles upstream of the reservoir.

19. The applicant currently operates the Project in a daily peaking mode with a weekly cycle (weekend storage mode depending on inflows and power demands) to optimize on-peak power production at the Project and at its three hydroelectric facilities on the mainstem of the Winooski River: Bolton Falls (FERC Project No. 2879), Essex No. 19 (FERC Project No. 2513), and Gorge No. 18 (unlicensed). Outflows from Waterbury Dam typically vary

[2] A true run-of-river project is one which does not operate out of storage and, therefore, does not artificially regulate streamflows below the project's tailrace. Outflow from the project is equal to inflow to the project's impoundment on an instantaneous basis. The flow regime below the project is essentially the river's natural regime, except in special circumstances, such as following the reinstallation of flashboards and project shutdowns. Under those circumstances, a change in storage contents is necessary, and outflow is reduced below inflow for a period.

between about 10 cfs (leakage when storing water) and about 620 cfs (generation)[3]. During normal summer operations, the reservoir is operated over a 2.0-foot band between elevations 588.5 feet and 590.5 feet. When inflows exceed station capacity, the reservoir can rise to the principal spillway crest at elevation 592.0 feet at which point overflow begins. Under the flood control operating protocol, the tainter gates are closed only if the Winooski River reaches action stage (elevation 417 feet, which is two feet below flood stage) at the Main Street bridge in Waterbury Village.

20. Beginning in late fall, the reservoir is drawn to an annual low between 540 and 560 feet by mid to late March. Snowmelt and spring precipitation runoff is then captured to attain the normal summer pool elevation of 589.5 feet by Memorial Day. The purpose of the drawdown is to maximize water utilization for power production by avoiding or lessening spillage through the dam principal spillway during periods of high inflow. This seasonal drawdown creates an average of about 26,000 acre-feet of storage, or the equivalent of 4.4 inches of runoff, before the principal spillway is activated.

21. The current federal license prescribes a minimum flow of 3 cfs. Leakage flows now exceed that value and have been estimated at about 10 cfs, a combination of dam seepage and wicket gate leakage.

22. The Project is unattended and is remotely operated from GMP's control center in Colchester.

Applicant Proposal for Relicensing

23. The applicant proposes certain modifications that would affect management of reservoir water levels and outflows over the term of the new license. A key proposal is replacement of the recently installed turbine runner within eighteen months of license issuance with a runner that has a reduced hydraulic capacity of 391 cfs and automated switching between the turbine and a bypass pipe[4] to maintain conservation flows during non-generation. Minimum conservation flow releases would be 108 cfs from April through June and 60 cfs from July through March. During any periods when inflow drops below these minimum flows, the applicant would release an estimated inflow equal to the daily flow measured at the downstream USGS gaging station adjusted for the change in storage contents.[5] The applicant expects that the modified turbine would be able to efficiently operate at the proposed conservation flows without cavitation problems.[6] Pending installation of the new runner, the applicant would continue current operations in terms of

[3] FERC in its final environmental assessment (August 15, 2005) indicated at p. 24 that the typical summer peak generation flow was about 490 cfs based on a review of the USGS gage data. Review of provisional gage data from April – June 2013 indicates that the peak is more on the order of 600-640 cfs currently.

[4] The existing valve on the 24-inch bypass pipe is designed for fully open or fully closed operation. Since it cannot be used to modulate outflows, GMP proposes to replace the valve.

[5] In an email of March 8, 2013, GMP indicated that it may use a surrogate gage to estimate inflows.

[6] The current unit cannot be safely operated at flows less than 266 cfs, and its best gate is 500 cfs (93% efficiency) based on field testing in February 2009 with the reservoir at approximately 592 feet in elevation. (Memorandum from Gomez and Sullivan Engineers to GMP, September 28, 2010)

the typical peaking discharge. The conservation flow bypass system would be in place "as soon as practicable." (Letter from Harriet Ann King, King & King, representing GMP, to Jon Groveman, ANR General Counsel, December 4, 2012)

24. Reservoir water level management would be modified in several ways. The maximum winter drawdown would be limited to elevation 550 feet. During spring refill, from March 15 through May 14, the reservoir would be managed as stable or rising "on a daily average basis"[7] until the normal summer range of 588.5 to 590.5 feet elevation is attained, with the exception of allowing drawdowns to prevent the reservoir from rising to elevation 592.0 feet and spilling. Under the exception, the reservoir would be returned to the pre-event elevation as soon as feasible. After May 14 and through Columbus Day (second Monday in October), the reservoir would be maintained within the two-foot normal summer range unless a surcharge occurs due to high inflows. After Columbus Day and until a full ice cover is established on the reservoir, the reservoir would continue to be operated within the two-foot range, with the exception that GMP may draw the reservoir to elevation 586.0 feet if a precipitation event of two or more inches is anticipated, after which the reservoir would be restored to the normal summer/fall operating range. After the ice cover is established and until the tainter gates are repaired, the reservoir would be drawn down to an elevation of no lower than 550 feet by March 14. After the tainter gates are repaired, the "base" drawdown would be to 570 feet. An additional ten-foot drawdown would be allowed regardless of the snowpack conditions if a two inch or greater precipitation event (presumably rainfall) is anticipated. Based on snowpack conditions, a further drawdown of ten feet, to elevation 550 feet, would be allowed. (Letter from Harriet Ann King, King & King, representing GMP, to Jon Groveman, ANR General Counsel, December 4, 2012)
25. The reservoir management proposal for the period after tainter gate repairs would be subject to review by an independent panel of experts "to assure that dam safety flooding impacts are protected under the new operations." (Letter from Harriet Ann King, King & King, representing GMP, to Jon Groveman, ANR General Counsel, December 4, 2012)

Standards Designation

26. The applicable 2011 Vermont Water Quality Standards (Standards) were adopted by the Vermont Water Resources Panel pursuant to 10 V.S.A. Chapter 47: Water Pollution Control. Section 1252 of the chapter provides for the classification of State waters as either Class A or Class B and authorizes the adoption of standards of water quality to achieve the purpose of classification.
27. The Little River is designated as Class B waters. Class B waters are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses. Values are high quality habitat for aquatic biota, fish and wildlife and a water quality that

[7] The Department interprets this to mean that the Project could release flows at rates higher than inflow as long as the average reservoir level for that calendar day does not drop below the previous day's average level.

consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation. (Standards, Section 3-04(A) Class B Waters: Management Objectives)

28. All waters affected by the proposal under consideration are designated coldwater fish habitat for the protection and management of fisheries. (Standards, Section 3-05. Fish Habitat Designation)

29. In Class B waters, the dissolved oxygen standard for coldwater fish habitat waterbodies is not less than 7 mg/l and 75 percent saturation at all times, nor less than 95 percent saturation during late egg maturation and larval development of salmonids in areas that the Secretary determines are salmonid spawning or nursery areas important to the establishment or maintenance of the fishery resource. At all times in all other waters designated as a coldwater fish habitat, the standard is not less than 6 mg/l and 70 percent saturation. (Standards, Section 3-04(B)(2) Water Quality Criteria for Class B waters: Dissolved Oxygen)

30. The temperature standard for coldwater fish habitat limits increases to 1.0°F from ambient conditions, or background. (Standards, Section 3-01(B)(1) General Criteria: Temperature)

31. The turbidity standard for coldwater fish habitat is either 10 NTU as an annual average under dry weather base-flow conditions or none in amounts or concentrations that prevent full support of uses. (Standards, Section 3-04(B)(1) Water Quality Criteria for Class B waters: Turbidity) Settleable solids and total suspended solids cannot be present in such concentrations that would prevent the full support of uses. (Standards, Section 3-01(B)(5) Water Quality Criteria for Class B waters: Settleable solids, floating solids, oil, grease, scum, or total suspended solids)

32. Under the Class B criterion for aquatic biota, wildlife and aquatic habitat, the Standards require "[n]o change from the reference condition that would prevent the full support of aquatic biota, wildlife, or aquatic habitat uses. Biological integrity is maintained and all expected functional groups are present in a high quality habitat. All life-cycle functions, including overwintering and reproductive requirements are maintained and protected." (Standards, Section 3-04(B)(4) Water Quality Criteria for Class B waters: Aquatic Biota, Wildlife and Aquatic Habitat). As the Little River has not been assigned a water management type, the criterion is "no change from reference conditions that would have an undue adverse effect on the composition of the aquatic biota, the physical or chemical nature of the substrate or the species composition or propagation of fishes." (Standards, Section 3-04(B)(4) Water Quality Criteria for Class B waters: Aquatic Biota, Wildlife and Aquatic Habitat)

33. The Hydrology Policy states, "The proper management of water resources now and for the future requires careful consideration of the interruption of the natural flow regime and the fluctuation of water levels resulting from the construction of new, and the operation of existing dams, diversions, and other control structures." (Standards, Section 1-02(E)(1)

General Policy: Hydrology Policy) For Class B waters, "[a]ny change from the natural flow regime shall provide for maintenance of flow characteristics that ensure the full support of uses and comply with the applicable water quality criteria." (Standards, Section 3-01(C)(1) Hydrology Criteria: Streamflow Protection)

34. The Anti-Degradation Policy provides for protection of existing uses and high quality waters. (Standards, Section 1-03. Anti-Degradation Policy)

Present Status

35. The Project was last licensed in 1954, well before the federal Clean Water Act. This certification action is the first formal review for compliance with Vermont Water Quality Standards.

36. On June 13, 2012, the U.S. Environmental Protection Agency approved a list of waters considered to be impaired based on water quality monitoring efforts and in need of total maximum daily load (TMDL) development to address the pollution. The Department submitted the list under Section 303(d) of the federal Clean Water Act. Waterbury Reservoir (Waterbody ID VT08-11L02) is listed for sedimentation and turbidity that impair aquatic life support and aesthetics. (State of Vermont 2012 303(d) List of Waters, Part A – Impaired Surface Waters in Need of TMDL, June 2012)

37. The Department concurrently issued a six-part list, List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d) in 2012. Part F lists those surface waters where water quality or habitat is being impacted by flow regulation. Waterbury Reservoir is listed due to water level fluctuations, while the Little River from Waterbury Dam to the mouth (Waterbody ID VT08-11) is listed due to artificial flow regulation by the Project. All designated uses are listed as impacted by flow alteration in the reservoir and the downstream reach of the Little River.

Water Chemistry and Physical Quality

Dissolved Oxygen and Temperature

38. Waterbury Reservoir, with a depth of ninety feet at the outlet conduit entrance, thermally stratifies during the summer. Under stratified conditions, the Project draws water from the hypolimnion, a zone where water characteristically has low oxygen content and cold temperatures. The Project discharges this cold, oxygen-deficient water into the tailrace. The applicant conducted monitoring in 1997 that showed substandard dissolved oxygen levels in August and September; eleven samples were collected in the tailrace during those months, and none met the saturation standard, while only one exceeded 7 mg/l. Recovery downstream to the USGS gaging station and through the gorge directly downstream of the gage appears to be good based on samples collected in those reaches; however, there may be a photosynthetic oxygen contribution from algae as the samples were collected well after dawn, limiting the ability to draw conclusions relative to diurnal low dissolved oxygen conditions for the reach downstream of the tailrace. (Application

for New License, Major Water-Power Project, for the Waterbury Hydroelectric Project – FERC No. 2090, Vol. 3, Appendix B – Water Quality Report, August 27, 1999)

39. The applicant proposes turbine venting to aerate water discharged through the station.[8] When the station is off line, flows would be routed through an existing valved 24-inch-diameter bypass pipe located on the east side of the powerhouse and discharging into the atmosphere, enabling reaeration; the pipe has a capacity of about 250 cfs at normal pool.

40. As part of the same study effort, temperature data was collected in the tailrace in 1997 and 1998 and in the Winooski River in 1997 and 1999.[9] The Department of Fish and Wildlife also collected temperature data for both rivers in 2002 and 2003. The Winooski River upstream of the Little River confluence is typically warmer than the Little River during low summer flows. Consequently, cooler water discharged from Waterbury Reservoir during generation periods reduces the Winooski River water temperature, which is beneficial to coldwater habitat. The watershed area at the dam comprises about 13% of the Winooski River watershed at the confluence of the two rivers. The current highly variable flow releases from the Project limits this potential benefit.

41. During the applicant's study, the average water temperature at the tailrace from mid-July to mid-August was about 10°C in 1997 and 16°C in 1998. Since the data was collected close to the dam, there is no diurnal variation since air temperature and solar gain are not factors at that location.[10] In contrast, the Winooski River often exceeds well over 20°C during low-to-moderate summer flows. Data collected by the Department of Fish and Wildlife in July 2003 showed temperatures commonly exceeding 24°C upstream of the Little River confluence. The Department of Fish and Wildlife collected more extensive data further downstream near Jonesville annually from 1998 to 2010, except in 2002. In eleven out of twelve years, the river temperature commonly climbed above 24°C during the summer (averaging 22 days), and in eight years climbed above 27°C as a daily high.

Turbidity and Sedimentation

42. Observations of the reservoir during the drawdown period indicate that sediments deposited when the reservoir is full are remobilized during the initial drawdown and

[8] Aeration options are discussed in the applicant's response to Additional Information Request No. 6 (Response to FERC Additional Information Request (July 20, 2000), February 1, 2001).

[9] The applicant also completed an extensive temperature study for the Little River and Winooski River in response to Additional Information Request No. 5 (Response to FERC Additional Information Request (July 20, 2000), February 1, 2001). Conditions were somewhat anomalous, however, as the reservoir was drawn down for dam repairs that summer starting in July 2000.

[10] The Little River from the dam to the mouth has a relatively intact, well vegetated riparian corridor, which limits the potential daytime increase in water temperature between the tailrace and the Winooski River. The applicant's data from 1998 suggests that the typical increase in temperature is less than 2°C and that most of the increase occurs upstream of the USGS station and gorge. The 1997 data, with a substantially colder tailrace temperature, showed increases of as much as 7°C, although most of the data showed virtually no change in temperature between the tailrace and mouth, or colder temperatures at the mouth after the reservoir apparently de-stratified. (While the 1998 temperature data was continuous, only random samples were available for 1997.)

again later during high spring inflows. About 450 acres (drawdown to elevation 550 feet) of the reservoir bed is exposed to erosion at the maximum drawdown. This includes about 10,600 feet of the original Little River channel and deltaic deposits that form at the mouths of reservoir direct tributaries, such as Cotton Brook at the north end and Stevenson Brook. The applicant monitored turbidity in the tailrace during 1997 and 1998 (Application for New License, Major Water-Power Project, for the Waterbury Hydroelectric Project – FERC No. 2090, Vol. 3, Appendix B – Water Quality Report, August 27, 1999) and 2000 (Response to FERC Additional Information Request (July 20, 2000), No. 7 – Water Quality Studies, February 1, 2001). The monitoring documented periods when tailrace turbidity exceeded the state standard of 10 NTU. The standard was exceeded on two occasions in March and April of 1998 (both 14 NTU), and once in April of 2000 (12 NTU). Sampling was limited to January through April/May, with eight tailrace samples in 1998, six tailrace samples in 1999, and 18 tailrace samples in 2000. All of the exceedences occurred when the reservoir was refilling or shortly after.

43. During the 2000 study, samples were collected at a station upstream of the reservoir (about 0.3 mile downstream of Millers Brook) and at an "inflow" station located at the reservoir/river interface, which moved depending on the drawdown status. At approximately the maximum drawdown for that year (elevation 558.8 feet), samples were collected on February 24. The turbidity at the inflow station exceeded standards at 35 NTU at the same time the upstream turbidity was only 2.0 NTU. While the study report speculates that this may be a sampling error, all of the sampling shows an increase in turbidity between the two stations when the reservoir is in drawdown condition.

44. The applicant conducted an assessment of the causes of high turbidity. The results of that assessment were contained in a project memorandum dated November 6, 2001 from Peter Soltys, BBC&M Engineering, Inc., the applicant's geotechnical consultant. Mr. Soltys noted that five of the dates of recorded high turbidities, including the dates when standards were exceeded, were preceded by adverse weather conditions of "periods of snow, freezing rain, hail, rain, and freezing temperatures followed by days of above freezing temperatures." He concluded that sediments exposed by the winter drawdown, mostly fine-grained lacustrine deposits, are particularly susceptible to erosion as a result of needle ice formation loosening the soil. The sediment-laden water enters the reservoir, setting up turbidity currents that flow by gravity toward the outlet. Along the way, these currents pick up additional sediment from the reservoir bottom. When this water is discharged, high tailrace turbidity readings result.

45. This phenomenon is a direct result of exposed sediments due to the winter drawdown. Mr. Soltys recommended "reducing the exposure of loosened sediments to the action of moving water." To reduce the extent of erosion, he recommends submerging two silt terraces to a minimum elevation of 570 feet before spring snowmelt and high inflows.

46. There are several active erosion sites along the reservoir shoreline that contribute to turbidity in the reservoir. In a shoreline erosion study, the applicant identified twelve sites where significant erosion is taking place. In all but one site, water level management was

identified as a contributing factor. Other factors include wind-driven waves and boat wakes. (Application for a New License, Major Water Power Project, Project, for the Waterbury Hydroelectric Project – FERC No. 2090, Vol. 3, Appendix C – Erosion Study, August 27, 1999)

47. USACE contracted for water quality monitoring in 2002 (May 31 – November 11) during the period when the reservoir was drawn down for major dam repairs, which commenced in 2000. The reservoir level varied between roughly elevation 520 feet and elevation 550 feet. Despite having been maintained in a drawn-down condition for two years, the downstream turbidity conditions continued to exceeded standards, with 78% of the 177 samples over 10 NTU. This in turn resulted in turbidity standard exceedences in the Winooski River, which was being sampled above and below the confluence as part of the monitoring program. The degradation of downstream water quality was more severe than the conditions found during the applicant's earlier study of the typical seasonal drawdown. Several factors may explain the difference, including the different time of year and climatic conditions, the more prolonged drawdown, and the oftentimes larger magnitude of the drawdown.

48. To reduce the turbidity problems created by the winter drawdown, the applicant proposes to delay the start of the drawdown until an ice cover forms and to limit the drawdown to elevation 570 feet unless a two-inch-or-greater precipitation event is projected or the snowpack water equivalent exceeds a certain to-be-determined amount. The ice cover would be intended to cover and insulate the exposed reservoir bed when the reservoir is drawn, reducing needle ice formation and exposure to rainfall. Mr. Soltys considered this option and characterized his reaction as "cautiously positive." He thought there may be a benefit as long as the ice did not melt before becoming refloated by the rising reservoir during refill. He stated that the actual benefit, if any, would only be known through a several-year trial period with turbidity monitoring.

49. The turbidity criteria changed with the 2008 Water Quality Standards. For coldwater habitat, the prior standard was simply 10 NTU. The criteria beginning with the 2008 version of the Standards is as described in Finding 31 above.

Aquatic Biota and Habitat

50. Management of reservoir water levels and outflows from the reservoir affects aquatic habitat quality in the reservoir, in the lower 2.7 miles of the Little River, and in the reach of the Winooski River from the Little River to Lake Champlain.

Reservoir

51. Shoreline areas act as a lake's "breadbasket" because of their high productivity. The penetration of sunlight into the shallow waters produces abundant plant growth. These plants provide food for other aquatic life, serve as spawning substrate for fish such as yellow perch, and provide cover for juvenile fish, forage fish and predator fish. Aquatic

invertebrate production is greatest in this area. Many fish seasonally use shoreline areas for spawning.

52. The dewatering of near-shore areas resulting from fluctuating water levels caused by the fall and winter drawdowns and daily peaking subjects the reservoir ecosystem to a major, annual disturbance. Healthy and stable littoral communities that provide habitat for fish and wildlife cannot develop, reducing the habitat value for a variety of species. Aquatic invertebrates that many fish rely on for food are greatly reduced. Fish that inhabit shoreline areas do not have the plant cover they need since many aquatic plants cannot become established due to the drawdown. These impacts may cause fish growth, survival and abundance to be low. Mortality of herptiles (e.g., frogs and turtles) that overwinter in the littoral zone is high due to exposure after hibernation has begun. Finally, the lack of aquatic vegetation exacerbates the erosion previously described.

53. Waterbury Reservoir is managed for high-quality habitat that will support self-sustaining populations of brown and rainbow trout, rainbow smelt, smallmouth bass, yellow perch and a suite of non-game fishes. The reservoir maintains desirable smallmouth bass and brown trout populations which support popular recreational fisheries.

54. Trout, smelt, and several nongame fish species within the reservoir move upstream into the Little River and other tributaries to spawn and feed.

55. Rainbow smelt in the reservoir spawn in the lower reaches of Stevenson Brook, Cotton Brook and smaller tributaries, as well as in the Little River directly upstream. Visual surveys by the Department of Fish and Wildlife in 21 years between 1990 and 2010 indicated that spawning began as early as April 11 and as late as May 3. In 1997, the reservoir was nearly ten feet below full pond elevation during the rainbow smelt spawning run, and smelt were unable to access normal spawning habitats in the tributaries. Use of alternate areas within the reservoir resulted in lowered spawning success due to silt covering the eggs and predation by suckers, yellow perch, and other species inhabiting the reservoir. Consistent observations were made in 1978 by former district biologist John Claussen: "The smelt run in 1978 was very small and rising water levels resulted in the smelt eggs being covered with silt." (Claussen. 1980. Waterbury Reservoir. Vermont Fish and Game Department. Federal Aid in Fish Restoration, F-12-R-13, Job I-3)

56. Reservoir-resident rainbow and brown trout also access the Little River, Stevenson Brook, and Cotton Brook for spawning. The spawning and incubation periods are April 1 – June 30 for rainbow trout and October 1 – May 31 for brown trout. Drawdowns during those periods can limit access to the brooks due to physical barriers caused by deposition in the normally submerged stream channels or due to turbidity resulting in disorientation of the fish or silt deposition on the redds.

Little River

57. The fisheries management goal for the Little River upstream and downstream of Waterbury Reservoir is a high-quality coldwater fishery supported by self-sustaining populations of resident and migratory salmonids and other associated coldwater species.

58. The Little River downstream of the reservoir currently supports a variety of riverine fish species, including brown, and rainbow trout, dace, suckers, and sculpin. Electrofishing surveys conducted by the Department of Fish and Wildlife indicate that fish abundance in the Little River is low, especially upstream of the gorge located directly below the gaging station. Populations in both the upper and lower reaches are probably affected by the extreme hydropeaking flow regime. Low levels of dissolved oxygen may be a further limiting factor in the reach above the gorge.

59. During 2008 and 2009, the Department's Biomonitoring and Aquatic Studies Program evaluated the condition of the macroinvertebrate and fish populations in the lower Little River, comparing population metrics to reference streams with similar physical characteristics. Population sampling also occurred in the river upstream of the reservoir and in Miller Brook. The investigators found that, while the Index of Biological Integrity scores for the fish populations at the sampling sites met the minimum standards for Class B water, the scores also reflected lower-than-expected total density and a depauperate top carnivore trophic level (i.e., low numbers of trout). The conclusion was that certain benthic fish species tolerant to fluctuating flows and consequently present in good numbers, such as longnose dace and slimy sculpins, atypically raised the scores. The macroinvertebrate at the sampling site closest to the dam (RM 2.2) failed to meet Class B criteria in 2008 and narrowly met the criteria in 2009; there was a loss of taxa of 40-50%, which was attributed to high-flow scour. The study report notes that the evaluation is limited to the *quality* of the habitat, and that the sufficiency of *quantity* (i.e., the flow regime) to provide high quality habitat would have to be assessed through other methodologies. (*Aquatic Life Use Support Attainment of the Little River below Waterbury Reservoir*, Vermont Department of Environmental Conservation, January 2010)

60. The applicant utilized a commonly used tool, the Physical Habitat Simulation System, or PHABSIM, to model the dynamic availability of preferred habitat for a suite of different fish species under alternate flows released from the Project. PHABSIM is part of the USGS's Instream Flow Incremental Methodology, or IFIM, used to negotiate flow regimes for activities that alter natural flows. PHABSIM is a model that simulates river hydraulics and habitat based on known species preferences for the specific physical habitat components of depth, velocity, and substrate. The end product is a set of weighted useable areas (habitat amount) as a function of streamflow at each critical life stage for an individual species of concern. Life stages typically include spawning and egg incubation, fry, juveniles, and adults. This information can then be used to negotiate conservation base flows for the calendar period associated with the critical life stages and peaking controls to address habitat disruption when flows are cycled between the minimum and a peak. PHABSIM does not factor in macrohabitat variables, such as dissolved oxygen and

temperature. Optimum flow conditions for one species of fish are unlikely to match optimum conditions for another species. So decision makers must determine best overall conditions for all key resident species.

61. Target fish species for the instream flow study were rainbow trout, brown trout, and longnose dace. Macroinvertebrate habitat was also modeled. To determine the best overall flow conditions, the Department of Fish and Wildlife completed a flow-optimization analysis[11] for macroinvertebrates and the three fish species in fry (July 1 – September 30), juvenile (year round), and adult (year round) life stages. Since the analysis assumed steady-state flows, loss of habitat due to peaking was not considered. Fry habitat was maximized at a flow of 30 cfs, with a flow of 60 cfs providing 82% of the habitat amount offered by 30 cfs. For juveniles and adults, habitat is maximized at a flow of 60 cfs. Macroinvertebrate habitat is maximized at 235 cfs, but the natural hydrology of the river would not sustain such a high flow; 80% of the maximum habitat amount is retained down to a flow of 90 cfs. For all fish and life stages, 50 cfs optimized habitat. With the inclusion of macroinvertebrates, 70 cfs optimized habitat.

62. The Department of Fish and Wildlife also analyzed spring spawning and incubation using the same steady-state approach for rainbow trout, longnose dace, and longnose sucker. For the three species, habitat is optimized at 131 cfs. Flows of about 85 cfs and 115 cfs provide 80 percent and 90 percent, respectively, of the maximum value. Rainbow trout spawning was maximized between 150 and 250 cfs.

63. Peaking reduces the amount of quality habitat available for the target fish species. Fish have evolved to adapt to natural flow regimes that are variable but substantially different from the artificial flow regime below the Project. Fish below the Project are subject to flows that vary hourly, daily, weekly, and seasonally and can change rapidly. Researchers have cited many problems related to peaking operations, including habitat loss, spawning disruption, disruption of fish movement and migration, reduced macroinvertebrate production, stranding of fish and macroinvertebrates, and dewatering of incubating eggs. Mobile organisms may be able to respond to an increase or decrease in flow by changing position, but in doing so, expend energy and may be subject to predation. Immobile organisms may be swept downstream by increasing flows or exposed by decreasing flows. Macroinvertebrates, mussels, fish eggs and small fish are generally assumed to be immobile within the context of a daily peaking environment. Consequently, the steady-state, flow-optimization analysis only paints part of the picture. Peaking can be factored in to determine the *effective* habitat using a PHABSIM dual flow analysis (HABEF).[12] Under the applicant's proposal, peaking would continue, although the maximum on-peak flow would be reduced to 391 cfs.

[11] Orth, D.J. and P.M. Leonard. 1990. Comparison of discharge methods and habitat optimization for recommending instream flows to protect fish habitat. Regulated Rivers: Research & Management5: 129-138.

[12] Milhous, R.T., M.A. Updike and D.M. Schneider. 1989. Physical habitat simulation system reference manual – version II. U.S. Fish and Wildlife Service Biological Report 89(16). Washington, D.C.

64. The applicant completed a dual flow analysis, which was evaluated by the Department of Fish and Wildlife. Peaking dramatically reduced the amount of habitat in the river compared to steady-state flow conditions at the proposed minimum flows. For example, the applicant proposes a non-spring minimum flow of 60 cfs coupled with an on-peak discharge of 391 cfs. Brown trout adult habitat is reduced on the order of 76% when cycling is factored in. Rainbow trout late-fry-stage habitat is reduced about 93%. (Letter from Jeffrey Cueto, ANR to Magalie Roman Salas, Secretary, FERC, Comments, Recommendations, Terms and Conditions, Waterbury Project, November 25, 2002)

Winooski River

65. Peaking operations at Waterbury Dam have a significant effect on flows in the lower Winooski. Several species of fish, including lake sturgeon and walleye, ascend the Winooski River from Lake Champlain to spawn downstream of Winooski City. Artificially fluctuating flows at this time of year can disrupt spawning and affect reproductive success.[13] Lake sturgeon is a state-listed endangered species.

66. Recognizing the importance of protecting this spring spawning use, the Department required spring run-of-river operation at the Essex No. 19 Hydroelectric Project when certifying (November 8, 1993) that facility for federal relicensing. The constraints were based on an IFIM study completed by GMP in 1991; spawning habitat in a 595-foot reach of the river directly downstream of the so-called Salmon Hole in Winooski was assessed. Fluctuating flows have persisted, however, due to peaking flow releases at Waterbury.

67. During five years of sturgeon spawning monitoring in the Winooski River, the Department of Fish and Wildlife observed egg deposition occurring between May 11 and June 1 (monitoring period, 2003-07) and larval drift as late as June 18 (monitoring period, 2004-05). The Essex No. 19 certification and license requires true run-of-river operation from April 1 through May 15, followed by a conservation flow of 1,000 cfs (1.0 cfs/sq. mile of watershed area), or inflow if less, through June 15, with the June flow targeted towards sturgeon egg incubation protection but also providing more stable conditions for bass and fallfish spawning use. During the period May 16 through June 15, the station can hydropeak but only if the minimum flow for the day is 1,000 cfs or higher; the maximum station capacity is 2,000 cfs (2.0 cfs/sq. mile of watershed area).

68. Data from USGS gages located downstream of the Waterbury project on the Little River and downstream of the Essex 19 project on the Winooski River show that Waterbury generation releases result in corresponding, significant flow fluctuations in the lower portion of the Winooski River during the sturgeon spawning period (April 1– June 15). For example, during May 10-16, 2013, provisional gage data shows the Waterbury Project generating at levels in excess of 600 cfs for a number of hours in the afternoon to

[13] Auer, N.A. 1996. Response of spawning lake sturgeons to change in hydroelectric facility operation. Transactions of the American Fisheries Society 125(1):66-77.

evening period, with rapid transitions to and from a base flow of about 10 cfs. These flow fluctuations are clearly visible some hours later when this water arrives at the Essex gage.

Lake Champlain Salmonid Restoration Program

69. The Winooski River is a major tributary to Lake Champlain and is a component of the Lake Champlain salmonid restoration and enhancement program. As part of the program, the Department of Fish and Wildlife has worked to restore landlocked Atlantic salmon to the river and to create a new run of migratory steelhead rainbow trout. The primary purpose of the steelhead introduction was to expand angling opportunities through the creation of a spring run of fish. Upriver habitat can be used as spawning and nursery habitat. The Department of Fish and Wildlife future hope is to re-establish self-sustaining populations of these fish so that stocking can eventually be reduced or eliminated.

70. A fish trap at the Chace Mill Project (FERC Project No. 2756) has been in operation since 1994. Returning salmon and steelhead were transported upstream around three dams, all of which have some type of downstream fish passage measures, and released near the head of the Essex No. 19 impoundment. These fish were able to move upstream as far as the Bolton Falls Project dam.

71. Upstream transport of fish caught at the trap was suspended in 2008 as a precaution against spreading viral hemorrhagic septicemia (VHS). Outbreaks of the VHS virus can result in severe fish mortality events in aquaculture as well as in wild populations. The VHS virus is readily transmissible to fish of all ages, and survivors of infection can be lifelong carriers. VHS has been confirmed in the Great Lakes and while it has not been detected in Lake Champlain, there is a significant risk that it could spread to Lake Champlain.

72. Cultured fish are currently being stocked in the Winooski River watershed below the Bolton Falls Project as part of this program. Steelhead and landlocked salmon smolts are stocked downstream of the lowest mainstem dam, and landlocked salmon fry are stocked in selected upriver habitats.

73. The Little River will be accessible to fish migrating upstream from Lake Champlain if the Department of Fish and Wildlife recommences upstream transport of fish from the Chace Mill trap and moves fish above the dam at Bolton Falls.

74. Waterbury Dam does not include facilities to enable upstream or downstream movement of migratory or riverine fish.

Wildlife and Wetlands

75. A diversity of wildlife uses the reservoir and adjacent lands. The area supports moose, white-tailed deer, and red fox, as well as several aquatic furbearers, including beaver, mink, and river otter. A 1,100 acre deer wintering area spans the northern portion of the reservoir. Shorebirds and waterfowl are abundant, including black ducks, Canada geese, and mallards. Loons have been observed but are not known to nest on the reservoir; loon

nesting is particularly susceptible to failure in reservoirs with fluctuating water levels. Bank swallows are very common, nesting in the actively eroding sandy banks around the reservoir. Several herptiles species, including frogs, toads, salamanders, and turtles, are present.

76. There are approximately 137 acres of wetlands associated with Waterbury Reservoir. Most wetlands are either palustrine forested/shrub-scrub or shrub-scrub/emergent wetlands. The largest complex (95 acres) is north of Cotton Brook. Two adjacent wetlands totaling 19 acres are located in the bay at the mouth of Bryant Brook in the east arm of the reservoir near Waterbury Center. The remaining wetlands are scattered around the reservoir. Examination of bathymetric maps indicates that additional wetlands would likely develop along the shoreline if the water level management regime more closely resembled a natural lake system.

77. Reed canary grass grows in extensive stands in the wetlands at the north end of the reservoir. This species can dominate sites, reducing the plant and habitat diversity. It flourishes in the presence of recurring or ongoing disturbance, such as that caused by major water level fluctuations. Japanese knotweed, another aggressive non-native plant, has also colonized the banks at the upper end of the reservoir.

78. Based on consultation with the Department of Fish and Wildlife Natural Heritage Program (July 1, 2013), there are no rare, threatened, or endangered species known to be present at Waterbury Reservoir.

Recreation

79. During the summer recreation season, the principal uses of the reservoir are angling, boating, paddling, swimming, water skiing, hiking and viewing. There are two state parks located on the reservoir. Waterbury Center State Park has a picnic area, beach, nature trails, ADA fishing platform, and boat ramp. Little River State Park, just north of the dam and at the mouth of Stevenson Brook, has a campground with 100 campsites, two beaches, and a boat ramp. It is within the Mt. Mansfield State Forest, and users have access to an extensive trail network that extends north to the Cotton Brook basin. Annual visitation at Little River State Park averages 23,000 campers and 3,700 day users. At Waterbury Center State Park, the annual average visitation is 23,000 day users; more recent data (2010-12) indicate that visitation has increased, averaging 37,000 day users for those three years.

80. Along the shoreline of the reservoir, there are 28 informal remote camping sites that are very popular during the summer months of July and August.

81. Three boat launches are available on State lands outside the parks. Cartop boat access is available at a launch located on the west shore at the upper end of the reservoir off Cotton Brook Road. Launches for trailered boats are located at the dam and at Blush Hill on the south shore of the east arm.

82. Ice fishing, a popular Vermont sport, is limited by the winter drawdown for safety and access reasons.

83. River users, including anglers and boaters have excellent access to the Little River downstream of the project. Most of the river is within the Mt. Mansfield State Forest or along its eastern border.

84. In October 2000, the applicant completed a whitewater boating flow study in consultation with American Whitewater and New England FLOW, a coalition of regional whitewater-recreation groups. Based on the study, 525 cfs was identified as the optimum canoeing flow, while kayakers preferred 415 cfs or 525 cfs. The minimum flow for use was 300 cfs. The applicant entered into an agreement with the parties in 2003. The agreement provides for scheduled whitewater flow releases between 400 cfs and 590 cfs, access improvements, and an enhanced flow information system. According to the FERC final environmental assessment, whitewater releases would be provided weekdays from 4 p.m. to 8 p.m., weekends from 11 a.m. to 3 p.m., and for special events during the boating season, June 1 through September 15. Access points to the river would be improved, and the existing security gate on the road to the powerhouse and dam would relocated about 550 feet closer to the dam to improve accessibility to the upper portion of the river.

85. In addition to enhancing downstream boating use, the applicant plans to install concrete pads at the Blush Hill and dam boat ramps; improve parking at the Blush Hill ramp; stabilize the access points for the cartop-boat access at the upper end of the reservoir; provide toilet facilities at the dam boat launch; and construct an ADA-compliant fishing platform at the reservoir. Except for the parking at Blush Hill, all improvements would be on State land outside of the project boundary, and maintenance would become the responsibility of the Agency of Natural Resources.

ANALYSIS

86. Operation of the hydroelectric station has well documented and profound impacts on the uses and values of Waterbury Reservoir, the Little River, and the Winooski River. Extensive discussions between the Department and GMP occurred throughout the relicensing process to identify and agree upon an operating configuration that restores and protects water quality as required by the Vermont Water Quality Standards and the Clean Water Act and its implementing regulations, enabling the Department to remove the reservoir and river downstream from its lists of impaired and priority waters while at the same time allowing for power generation.

87. The opportunities at Waterbury Reservoir are great in terms of ecological improvement of the reservoir and the river downstream, as well as enhancement of the public use and enjoyment of these resources. The reservoir is one of Vermont’s largest lakes by surface area and has an undeveloped shoreline that is almost entirely in public ownership.

88. The applicant's proposals to upgrade the turbine with a runner that can operate efficiently over a lower range of flows and to automate the 24-inch-diameter bypass pipe are important elements of an acceptable solution. However, the overall solution must include constraints on reservoir water level and downstream flow management that assure compliance with the Standards over the term of the license.

89. The Project must be operated in a manner that fully supports designated uses for Class B waters as required by the Standards. Waterbury Reservoir and the Little River downstream are currently listed as priority waters not supporting designated uses. Of particular concern are non-support of aquatic biota, wildlife, and aquatic habitat, aesthetics, and recreational uses, such as swimming and angling. A goal of the Standards and the Clean Water Act is to restore the biological integrity of waters such that aquatic biota and wildlife are sustained by high quality habitat.

90. The annual drawdown prevents the establishment of a rich diversity of native aquatic plants that would provide a high quality habitat for fish and wildlife. A water level management scenario that more closely mimics a natural system would improve wetland function and development of a littoral plant community.

91. The applicant conducted an instream flow study using the USGS's Instream Flow Incremental Methodology, which is recognized under Section 3-01(C)(2) Hydrology Criteria as an acceptable methodology for site-specific habitat studies. Based on the study results, the minimum flows proposed by the applicant, coupled with continued peaking, would not provide high quality habitat for all fish species of interest. It is unlikely that, for example, a coldwater sports fishery can be established downstream under the applicant's flow proposal. With a minimum flow of 60 cfs and continued peaking as proposed by the applicant, brown trout adult habitat is reduced by about 76% and rainbow trout late-fry-stage habitat by about 93%. Persistence of low numbers of trout would reflect a biological integrity that is less than high quality. Further, angling would continue to be unsupported.

92. Stabilizing the reservoir at the current summer normal pool is the only alternative that would restore and protect water quality and comply with the Standards. Stabilization would improve water clarity in the reservoir; reduce shoreline erosion; assure access to spawning tributaries for reservoir fish that use those tributaries in the spring and fall; enhance and protect wetlands around the reservoir; optimize downstream flows in the Little River and Winooski River for fish and other aquatic biota; protect aesthetics to the extent that value is degraded by the drawdown and exposure of the reservoir bed; enable the development of a productive littoral zone around the reservoir; enhance boating and angling uses, including ice fishing and the development of a classic coldwater sports fishery associated with the deep-water release; provide a more consistent flow of cold water into the Winooski River during the summer; and reduce artificial fluctuations of flow in the Winooski River from Waterbury downstream.

93. The Department recognizes that stabilization is a relative term. Water levels would continue to fluctuate in the reservoir, but the water fluctuations will be more similar to what occurs in a natural lake. With the station's reduced hydraulic capacity and the elimination of seasonal drawdowns, the reservoir would more frequently rise above elevation 592 feet.

94. This certification is being conditioned such that drawdowns below 588.5 feet will no longer occur as part of the hydroelectric operation and the operating mode will become instantaneous run-of-river. Before the Project can be fully converted to year-round run of river, three modifications of the civil works are necessary replacement of the existing 24-inch bypass pipe's valve with an automated valve capable of modulating flows; replacement of the turbine with a unit capable of operating efficiently over a broader range of flows; and spillway replacement, including the repair of the tainter gates. As described in Findings 9-10, the spillway replacement will involve the State of Vermont entering into a Project Cooperation Agreement with the federal government. Consequently, this certification allows for interim operations that recognize three different stages as outlined under Interim Operations in Condition B.

95. The continuation of the seasonal drawdown during the first two stages is specifically to address dam safety concerns. Initiating the spring refill by March 15 and maintaining a rising or stable water level should help assure suitable access and spawning conditions for rainbow smelt.

96. Under interim operations during the spring period (an increased minimum flow release of 108 cfs and reservoir levels that are rising or stable), sturgeon and walleye spawning in the lower Winooski River would not be subjected to the magnitude of flow fluctuations currently experienced. However, this conclusion is predicated on the rising-or-stable condition being instantaneous and not a daily average as proposed and run-of-river operations through June 15 after the reservoir reaches the target range.

97. To assure dissolved oxygen standards will be met, the Department accepts the applicant's proposal to vent the turbine and is so conditioning this certification. Dissolved oxygen monitoring is being required to verify adequacy.

98. This certification is also requiring the development of a recreation plan in consultation with the departments of Environmental Conservation, Fish and Wildlife, and Forests, Parks, and Recreation, subject to Department approval. The recreation improvements proposed by the applicant are to be reviewed to determine if still appropriate and, if so, incorporated in the plan, with the exception of special whitewater boating releases, which would conflict with the run-of-river operation. The applicant has agreed to update its recreation proposal based on input from the departments as long as the funding allocation remains the same.

Anti-degradation

99. Pursuant to the Anti-Degradation Policy set forth in Section 1-03 of the Standards and the Agency's 2010 Interim Anti-Degradation Implementation Procedure (Procedure), the Secretary must determine whether a proposed discharge or activities are consistent with the Policy by applying the Procedure during the review of applications for any permit for a new discharge if during the application review process compliance with the Standards is evaluated pursuant to applicable state or federal law. (Procedure III(A)) This includes water quality certifications required by Section 401 of the federal Clean Water Act for a federal license or permit for flow modifying activities. (Procedure III(B)(3))

100. In making the determination that proposed activities are consistent with the Policy, the Secretary is required to use all credible and relevant information and the best professional judgment of Agency staff. (Procedure III(D)) Section VIII of the Procedure governs the Agency's review of Section 401 applications for flow modifying activities. (Procedure VIII(A)(1)) Under Section VIII of the Procedure, the Secretary must conduct either a Tier 3 review to protect Outstanding Resource Waters (designated by the Secretary under 10 V.S.A. § 1424a), a Tier 2 review to protect high quality waters, or a Tier 1 review to protect existing uses of waters. For Tier 2, a waterbody will be assessed as high quality on a parameter by parameter basis. (Procedure VIII(E)(1)(b)) Therefore, the Secretary may have to review a single waterbody under multiple tiers of review depending on whether a waterbody is impaired or high quality for different parameters.

101. This Project does not affect any Outstanding Resource Waters and therefore does not trigger a Tier 3 review under Section VIII of the Procedure.

102. This Project affects Class B waters, which are high quality waters for certain parameters that trigger a Tier 2 review under Section VIII of the Procedure. (Procedure VIII(E)(1)(c)) Under Tier 2, the Secretary must determine whether the proposed discharge will result in a limited reduction in water quality in a high quality water by utilizing all credible and relevant information and the best professional judgment of Agency staff. (Procedure VIII(E)(2)(b))

103. When conducting a Tier 2 review, the Secretary may consider, when appropriate, one or more of the following factors when determining if a proposed new discharge will result in a reduction in water quality: (i) the predicted change, if any, in ambient water quality criteria at the appropriate critical conditions; (ii) whether there is a change in total pollutant loadings; (iii) whether there is a reduction in available assimilative capacity; (iv)

the nature, persistence and potential effects of the pollutant; (v) the ratio of stream flow to discharge flow (dilution ratio); (vi) the duration of discharge; (vii) whether there are impacts to aquatic biota or habitat that are capable of being detected in the applicable receiving water; (viii) the existing physical, chemical and biological data for the receiving water; (ix) degree of hydrologic or sediment regime modifications; and (x) any other flow modifications. (Procedure VIII(E)(2)(d))

104. The Secretary considered the foregoing factors during the review of the Project. The principal impact of the Project is its effect on water levels in Waterbury Reservoir and downstream flows in the Little River and Winooski River. With the exceptions of shoreline erosion and the mobilization of sediment in the reservoir resulting in turbid discharges downstream, discharge of pollutants is not an issue. Stabilization of reservoir water levels is expected to reduce both mobilization of reservoir sediments and shoreline erosion, thereby improving turbidity. The changes in project operation will not result in a discharge of additional pollutants. Other ambient water quality criteria will improve or remain unchanged. Furthermore, impacts to aquatic biota and habitat will be reduced with a more stable reservoir water level and downstream conservation flows and reduced hydropeaking.

105. The conditions included in this certification provide the Department assurance that the Project will not result in any reduction in water quality for those parameters for which the Winooski River and Little River are exceeding water quality standards. Moreover, the conditions will serve to protect and enhance water quality. This certification does not authorize any activities that would result in a lowering of water quality for those parameters that are exceeding water quality standards.

106. For those parameters for which the Waterbury Reservoir and Little River are not exceeding water quality standards, the Secretary must conduct a Tier 1 review.

107. Under Tier 1 review, the Secretary may identify existing uses and determine the maintenance necessary to protect these uses. (Procedure VIII(F)) In determining the existing uses to be protected and maintained, the Secretary must consider the following factors: (a) aquatic biota and wildlife that utilize or are present in the waters; (b) habitat that supports existing aquatic biota, wildlife, or plant life; (c) the use of the waters for recreation and fishing; (d) the use of the water for water supply, or commercial activity that depends directly on the preservation of an existing high level of water quality; and (e)

evidence of the uses' ecological significance in the functioning of the ecosystem or evidence of the uses' rarity. (Procedure VIII(F)(2))

108. The Secretary considered all of the factors listed above and, based on information supplied by the applicant and Agency staff field investigations, identified the following existing uses: aquatic biota, wildlife and aquatic habitat; aesthetics; swimming; whitewater paddling and fishing.

109. The existing dam and reservoir have changed the natural condition of the river at the Project location. Currently, all uses are impacted in the Waterbury Reservoir and the Little River due to water level and flow fluctuations. However, the modifications to the Project conditioned under this Certification will result in improvements to water quality, which will protect and improve conditions for existing and designated uses. Those modifications include reduced reservoir water level and downstream flow fluctuations; mitigation of dissolved oxygen impacts of the reservoir and a reduction in reservoir turbidity.

110. The Secretary must also consider certain factors in identifying existing uses. In identifying contact and non-contact recreation, fish and public surface water supplies, the Secretary must consider the information that the applicant submitted in accordance with the *Agency's Process for Determining Recreational Uses*; information gathered in accordance with the *DEC 2008 Basin Planning Procedure for Determination of Existing Uses* during the development of basin plans; any relevant information from an applicable basin plan; and any other relevant information regarding use of the receiving waters for contact and non-contact recreation, fishing and public surface water supplies. (Procedure VIII(F)(3)(a)) In identifying all other uses, including aquatic habitat, biota, and wildlife, the Secretary must presume that if the designated uses of the receiving waters are currently being achieved and will continue to be achieved after evaluation of the proposed activity, then any identified existing uses will also be maintained and protected. (Procedure VIII(F)(3)(b))

111. The Secretary considered information supplied by the applicant, relevant Agency documents and information obtained during field investigations, and has identified fishing and boating as existing uses. Protection of aquatic habitat is the designated use most sensitive to the effects of the Project. Consequently, the Secretary presumes that if aquatic habitat is supported then these additional existing uses will likewise be supported. (Procedure VIII(F)(3)(b))

112. The Secretary finds that development and operation of the Project as conditioned by this Certification will not result in any change in existing physical and water quality conditions beyond those that have already taken place as a result of prior development at the site. Accordingly, the Secretary finds that the Project meets the requirements of the Policy and Procedure relating to the protection and maintenance of high quality waters.

Decision and Certification

The Department has examined the project application and bases its decision in this Certification upon an evaluation of the information contained therein that is relevant to the Department's responsibilities under Section 401 of the federal Clean Water Act and has examined other pertinent information deemed relevant by the Department, sufficient to permit the Department to certify that there is reasonable assurance that operation and maintenance of the Waterbury Hydroelectric Project as proposed by the applicant and in accordance with the following conditions will not cause a violation of Vermont Water Quality Standards and will be in compliance with sections 301, 302, 303, 306, and 307 of the Federal Clean Water Act, 33 U.S.C. §1251 et seq., as amended, and other appropriate requirements of state law. The Department has deemed that the following conditions are necessary to find reasonable assurance that the project's activity will be conducted in a manner which will not violate water quality standards.

A. Compliance with Conditions. The applicant shall operate and maintain this project consistent with the findings and conditions of this certification, where those findings and conditions relate to protection of water quality and support of designated and existing uses under Vermont Water Quality Standards and other appropriate requirements of state law.

B. Reservoir and Outflow Management. The applicant shall operate the station in a true run-of-river mode using the turbine and/or bypass flow pipe to match instantaneous inflow up to the hydraulic capacity of the system (Stage III). When inflows exceed the system capacity, the system shall continue to release water at its maximum capacity until inflows recede and the reservoir begins to approach the normal operating level (NOL) at which point the system will be ramped down to match inflow while avoiding a sudden drop in releases. The system shall be operated for smooth transitions in outflows, such as when the turbine is brought on line.

The NOL shall be elevation 588.5 feet, elevation 589.5 feet, or an elevation in between, as selected by the applicant. The applicant shall indicate what its selected NOL is in the flow management plan (Condition D below).

Interim operations: There are two stages of operation before the tainter gates are replaced and the Project can be converted to Stage III (year round run-of-river operation): Stage I (existing conditions) and Stage II (automated valve installed on 24-inch bypass pipe and new turbine installed).

During **Stage I**, the applicant shall maintain conservation flows of 30 cfs if the Department determines it is feasible based on a construction and engineering assessment of the applicant's existing infrastructure at the Project. The applicant shall also maintain reservoir levels within 1.0 foot of the NOL from the date the seasonal reservoir refill is completed through January 1, or the commencement of the seasonal drawdown, if later. When reservoir inflows are lower than the hydraulic range of the turbine, the maximum generation release shall be 300 cfs.

During **Stage I**, the reservoir shall be drawn seasonally beginning no earlier than January 1 to an elevation no lower than 550 feet. Spring refill shall commence no later than March 15 with reservoir levels rising or stable at all times until the NOL is reached by no later than May 15. During the seasonal drawdown, the maximum instantaneous outflow shall be 300 cfs, or inflow if greater.

During **Stage I**, except when the reservoir is undergoing the seasonal drawdown and refill, operation shall either match inflow if inflow is within the hydraulic range of the turbine or be at full turbine capacity if inflow exceeds turbine capacity. This constitutes the Stage I run-of-river component of operations.

During **Stage II**, the applicant shall modify the run-of-river component of operations consistent with the new hydraulic capabilities provided by the automated valve and the new turbine.[14] When the applicant is drawing down the reservoir, 60 cfs conservation flow shall be a fixed minimum flow (i.e. "or inflow if less" will not apply) until an elevation of 550 feet is reached at which time outflows shall match inflows. The applicant shall maintain a conservation flow of 60 cfs or inflows if less from March 16 through March 31, and 108 cfs or inflows if less from April 1 through May 15.

Outside of the seasonal drawdown/refill period, the applicant shall use the valve up to its full capacity when inflows exceed the turbine capacity, except after June 15. After June 15, use of the valve may be suspended if the reservoir level is below elevation 592.0 feet and inflow is less than the maximum capacity of the turbine. Otherwise, the operational description for Stage I will continue to apply, except the maximum instantaneous outflow during the seasonal drawdown in Stage II shall be 200 cfs, or inflow if greater.

The applicant shall use ramping procedures when necessary to address flow transitions during conditions when the station is not being operated in a manner that matches inflow during **both stages**. This would include, for example, 1) the transition back to a true run-of-river mode after the reservoir rises above the NOL following a high-inflow event; 2) changing from run-of-river operation to an outflow higher than

[14] During Stage II (new turbine and automated valve), run of river will be possible up to a lower maximum flow as the new unit is expected to have a lower hydraulic capacity compared to the existing unit. The applicant will have to address hydraulic capacities in its flow management plan (Condition D) for reservoir levels lower than the current normal summer pool.

inflow for the purposes of the seasonal drawdown; 3) stabilizing the pool at the low winter drawdown level at the conclusion of the winter drawdown; and 4) the limited cycling during Stage I. The ramping procedures shall provide for incremental changes in flow that do not exceed 60 cfs per 30-minute period for ramping up and 30 cfs per 30-minute period for ramping down. In cases of operator error or unanticipated problems, a greater ramping rate may be used if necessary to avoid drawdowns below the NOL.

C. The applicant shall begin Stage I operations within 30 days upon receiving license renewal from the Federal Energy Regulatory Commission. The applicant shall begin final design work for the turbine runner and the new bypass pipe with an automated valve within 30 days of issuance or by August 1, 2015, whichever is first.

The applicant shall complete design work for the turbine runner and new bypass pipe with an automated valve no later than December 1, 2015 at which time the applicant will begin the bidding and contracting process.

The applicant shall complete selection of a contractor and contract negotiations no later than March 1, 2016. At this time, the Applicant will begin to order equipment and begin staging and other site preparation work to install the new equipment.

The applicant shall begin construction by closing the broome gate by September 8, 2016 and the applicant shall complete construction of the pipes, valves and runner replacement by December 31, 2016.

The applicant shall begin Stage II operations no later than January 1, 2017.

The applicant shall begin Stage III operations within 30 days after the spillway is replaced, including gate repairs, and the Department determines, based on a recommendation from the federal government, that the Stage III operational phase may be safely implemented, whichever is later.

The Department may order emergency drawdown consistent with a protocol developed by the Department that sets forth criteria and/or factors and a process to be utilized in determining whether drawdown is necessary to protect the public health, safety, and welfare.

D. Bypass Flow Pipe. Within eighteen months of license issuance, the applicant shall automate the valved 24-inch-diameter bypass pipe to enable the turbine/bypass flow pipe system to match normal inflows and meet the terms of the interim operation.

Reservoir and Flow Management and Monitoring Plan. The applicant shall develop a reservoir and flow management plan detailing how the project will be operated to comply with the flow and water level limitations described above.

The plan shall be developed in consultation with the Department and the U.S. Fish and Wildlife Service, and the plan shall be submitted to the Department for review

within 60 days of the issuance of a federal license. The plan shall be subject to Department approval. The Department reserves the right of review and approval of any material changes made to the plan at any time and the right to request revisions to the plan if necessary to assure compliance. Compliance records shall be kept permanently and provided to the Department on request in a format specified by the Department.

The plan shall include provisions for monitoring and reporting to the Department compliance with the flow and water level requirements set forth in this certification. At a minimum, the reports shall include hourly turbine flows, hourly 24-inch-diameter bypass pipe flows, hourly 48-inch-diameter bypass pipe flows (if used), hourly reservoir elevations, and tainter gate status.

The plan shall include procedures for reporting to the Department deviations from prescribed operating conditions and continuation of funding for the operation of the USGS gages associated with the Project (USGS gages nos. 04288500 and 04289000). In reporting deviations, the applicant shall include an explanation of the cause; propose steps to be taken to prevent a recurrence; and revise the flow management plan if requested to do so by the Department.

E. The plan shall include a detailed description of ramping procedures. The Department considers operator error or unanticipated problems that necessitate ramping rates that exceed 60 cfs per 30-minute period as deviations from the prescribed operating conditions reportable to the Department as described below.

If necessary in order to assure stable reservoir levels and consistent downstream flows, the applicant shall install an upstream gage on the Little River to enable accurate estimation of instantaneous inflows.

F. Tailrace Dissolved Oxygen. The applicant shall develop a plan for measures to meet dissolved oxygen standards in the river directly downstream of the power station. The plan shall include a proposal for equipment and/or structural or mechanical modifications to address the dissolved oxygen deficiency, a schedule for implementation, and any dissolved oxygen monitoring protocols necessary to determine when turbine venting or other measures will be initiated. The plan shall be developed in consultation with the Department, and the applicant shall submit the plan to the Department for review within 90 days of the issuance of a federal license. The plan shall be subject to Department approval. If violations of dissolved oxygen standards persist after implementation of the plan, the applicant shall revise the plan to include additional or alternate measures to meet dissolved oxygen standards. Any revised plan shall be subject to approval by the Department prior to implementation. The Department's preference is for a passive reaeration system. Routine dissolved

oxygen monitoring data shall be included with the reservoir and flow management monitoring records.

G. Dissolved Oxygen Effectiveness Monitoring. The applicant shall develop a plan for monitoring dissolved oxygen and temperature in the penstock and the river directly downstream of the power station during periods of reservoir stratification and verifying the effectiveness of the dissolved oxygen enhancement measures. The plan shall be developed in consultation with the Department, and the plan shall be submitted to the Department for review within 90 days of the issuance of a federal license. The plan shall be subject to Department approval. Following approval of the monitoring plan, the applicant shall measure dissolved oxygen and temperature and file records of these results annually with the Department by the end of the same calendar year. The filing shall include graphs comparing the penstock dissolved oxygen concentration and percent saturation to the downstream dissolved oxygen concentration and percent saturation, showing whether flows are being routed through the turbine or the bypass pipe, and, if through the turbine, showing whether the reaeration mechanism is being used at the time. Following the initial five year monitoring period, the Department will review the data and may suspend this requirement, all or in part.

H. Fish Passage. Upon a request of the Department of Fish and Wildlife, the Department may require the applicant to provide upstream or downstream fish passage facilities or participate in a trap-and-transport facility that moves migratory fish upstream of Waterbury Dam.

I. Turbine Rating Curves. The applicant shall provide the Department with a copy of the turbine rating curve, accurately depicting the flow/production relationship, for the record within one year of the issuance of a federal license.

J. Maintenance and Repair Work. Any proposals for project maintenance or repair work shall be filed with the Department for prior review and approval, if said work may have a material adverse effect on water quality or cause less-than-full support of an existing use or a beneficial value or use of State waters.

K. Recreation Plan. Recreational facility improvements shall be constructed consistent with a Department-approved recreation plan. The plan shall include an implementation schedule and, where appropriate, details on erosion prevention and sediment control. The plan shall be developed in consultation with the departments of Environmental Conservation, Fish and Wildlife, and Forests, Parks, and Recreation and filed with the Department within six months of license issuance for approval.

L. Compliance Inspection by Department. The applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.

M. Posting of Certification. A copy of this certification shall be prominently posted within the project powerhouse.

N. Approval of Project Changes. Any change to the project that would have a significant or material effect on the findings, conclusions or conditions of this certification, including project operation, must be submitted to the Department for prior review and written approval where appropriate and authorized by law and only as related to the change proposed.

O. Reopening of License. The Department may request, at any time, that FERC reopen the license to consider modifications to the license as necessary to assure compliance with Vermont Water Quality Standards.

P. Continuing Jurisdiction. By condition of this certification, the Department retains continuing jurisdiction over the Project and may reopen this certification to assure compliance with the Standards and to respond to any changes in classification or management objectives for waters affected by the Project.

Dated at Waterbury, Vermont this ____ day of December, 2014

By _____
David Mears, Commissioner
Department of Environmental Conservation

Reviewed by:

_____
Louis Porter, Commissioner
Fish and Wildlife Department

Appended: GMP proposal for certification, December 4, 2012

RECEIVED
DEC 12 2012
WSMD

GREEN MOUNTAIN POWER CORPORATION
WATERBURY HYDROELECTRIC PROJECT
401 WATER QUALITY CERTIFICATE PROPOSAL
December 4, 2012

Conservation Flows

Proposal: The minimum flows set forth below, proposed for the entire license term, are consistent with the conservation flows proposed by ANR.

April 1 – June 30: 108 cfs or inflow[1], whichever is less

July 1 – March 31: 60 cfs or inflow, whichever is less

Rationale:

April 1 – June 30:

Drainage area prorated using the Essex 19 minimum spring flow of 1,000 cfs. This will assist with meeting walleye and lake sturgeon spawning flows below Essex 19.

July 1- March 31:

This flow will provide greater than 90% of the maximum habitat available for all fish species with the exception of spawning brown trout and spawning longnose sucker. For the latter two species this flow will provide greater than 80% of the maximum habitat.

Downstream Flow Management

Proposal:

2013 until new turbine runner is installed: Existing operations with turbine aeration (form to be determined) and automatic switching between turbine and low level outlet discharge during non-generation periods to be installed as soon as practicable.

New Turbine Runner: GMP will install a new turbine runner at the Waterbury Hydroelectric Facility within two years of FERC license issuance. The new runner will have a design maximum generation discharge of 391 cfs with an associated electrical capacity of 4.1 MW.

Rationale:

- It is anticipated that the upgraded unit will be capable of providing the full range of conservation flows.

[1] Inflow will be calculated on a daily basis using the following equation: Inflow - Outflow = Change in Storage, where Outflow = Little River flow as measured at the USGS gage downstream of Waterbury Dam (Gage No. 0428900) and Change in Storage = Start of Day Storage – End of Day Storage, as measured using the reservoir stage-storage curve and starting and ending water surface elevations for the day.

- The reduction from the current maximum generation flow will provide significant fisheries benefits in the Little River, including improved habitat conditions for invertebrates and immobile lifestages of fish species.
- Turbine aeration will address seasonal dissolved oxygen deficit concerns

Reservoir Management

Proposal: GMP is proposing significant changes to the winter drawdown after the new tainter gates become operational as described below. The proposed changes are subject to review by an independent panel of three experts chosen by GMP and VANR to determine if the proposed drawdown levels are adequate to protect dam safety as well as minimize reservoir and downstream flooding.

2013 until New Tainter Gates are Operational:	Post New Tainter Gates becoming Operational:
3/15 to 5/14: stable or rising to 589.5 ± 1.0 ft. on a daily average basis but allow drawdown if a rainfall/snowmelt event is anticipated to fill the reservoir to an elevation greater than 592 ft. Refill to pre runoff event elevation as soon as possible.	**3/15 to 5/14:** Same as column 1.
5/15 – Columbus Day: 589.5 ± 1.0 ft.	**5/15 to Columbus Day:** 589.5 ± 1.0 ft. Same as column 1.
Columbus Day until full ice cover in Waterbury Reservoir: 589.5 ± 1.0 ft, but allow drawdown to 586.0 ft. if a 2" or greater precipitation event is anticipated. Refill to 589.5 ± 1.0 ft. as soon as possible after the storm danger has passed.	**Columbus Day until full ice cover in Waterbury Reservoir:** Same as column 1.
Full ice cover to 3/14: max drawdown to 550 ft.	**Full ice cover to 3/14:** ➢ Base drawdown to 570 ft. ➢ Additional drawdown to 560 ft. if a 2" or greater precipitation event (1-yr, 24-hr storm) is anticipated regardless of snowpack equivalent. ➢ Develop snowpack/water equivalent monitoring system and associated drawdown in consultation with VANR. Based on snowpack water equivalent, additional drawdown to elevation 550 ft. allowed

Rationale:

3/15 – 5/14

- Within the constraints of spring runoff and filling the reservoir, allows for tributary access by spawning rainbow trout and rainbow smelt.

- Spring and fall drawdown and refill flexibility is needed to minimize increased dam safety/flooding risk of significant runoff events, the exact timing and magnitude of which are unknown (i.e. spring 2011 where reservoir rose to elevation 611 ft.)

5/15 – Columbus Day:

- Extend the summer full pool from Labor Day, as currently operated, to Columbus Day to facilitate later boating use of the reservoir

Columbus Day – Full Ice Cover:

- Within the constraints of fall runoff to the reservoir, allow for tributary access by spawning brown trout.
- Extending the period of high reservoir levels until full ice cover will protect the littoral zone from desiccation until an insulating layer of ice is formed.
- The drawdown to 586 ft. pending a 2" precipitation event (1 yr, 24 hour storm) is designed to accommodate fall rains within the reservoir.

Full ice cover to 3/14:

- For dam safety purposes until the tainter gates are repaired, GMP's existing winter drawdown operations are maintained.
- During this period GMP and VANR will convene an independent panel to review if the proposed drawdown levels (post tainter gate repair) are adequate to protect dam safety as well as minimize reservoir and downstream flooding.
- During this period GMP will develop, in consultation with VANR, a snow survey/anticipated runoff system for active winter management of the reservoir storage volume.
- If the drawdown levels proposed adequately protect dam safety and flooding, the 570 ft. base elevation drawdown will reduce needle ice formation on reservoir sediment deltas. Needle ice reduction is anticipated to reduce turbidity.
- Waiting to drawdown until full ice cover will insulate the littoral zone areas.

Recreation

Proposal:

GMP is proposing the following capital improvements for recreation facilities consistent with its FERC license application. For the reservoir sites with the exception of the Blush Hill Boat Ramp, all of the facilities are owned and maintained by VDFPR or VDEC and are outside the Project Boundary. Ongoing operation and maintenance of the facilities will be the responsibility of the State of Vermont.

Location	Enhancement	Estimated Cost (1999 Dollars)
Little River	Powerhouse access road improvements	$ 8,681
	Improvements to user-created trails/access points	$ 11,754
	Provision of one or more boat carry-in sites	$ 17,171
	Provision of safety and other signing	$ 250
	Improved parking conjunction with the snowmobile crossing	$ 10,585
	Installation of a flow phone system	minimal
Reservoir	Sanitary facilities at the boat launch adjacent to the dam	
	2-unit vault	$ 8,000
	2-unit composting	$ 22,000
	Concrete launch pads at the dam and at Blush Hill access sites	$ 69,168
	Provision of an ADA accessible fishing platform	$ 7,334
	Blush Hill access parking and turn-around improvement	$ 10,167
	Stabilization/hardening of the Moscow canoe-launch	$ 5,118
	Approximate Total	$ 170,000

Rationale:

These facility improvements were developed in consultation with VDFPR and VDEC during the consultation on the original license application. At a 4% annual escalation rate the equivalent cost of these facilities in 2012 dollars is approximately $283,000.